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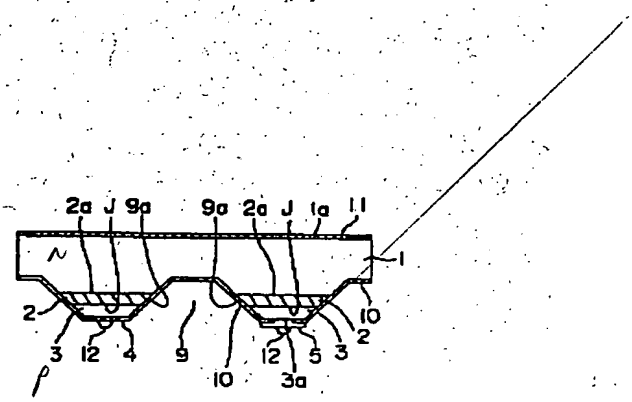
## (54) SEMICONDUCTOR LIGHT EMITTING DEVICE

(57) Abstract:

PURPOSE: To provide a semiconductor light emitting device which can be improved in light emitting efficiency and, at the same time, can be easily mounted.

CONSTITUTION: This device is provided with a groove 9 which reaches an N-type substrate 1 from the surface 3a of a P-type semiconductor section 3 counterposed to a P-N junction surface J through the P-N junction surface J and N-type semiconductor section 2 and a P- and N-electrodes 5 and 4 formed on the surface 3a on both sides of the groove 9. In addition, bump electrodes 12 are respectively installed to the electrodes 5 and 4. Therefore, no light intercepting electrode is formed on the light emitting surface 1a of the device. In addition, flip chip bonding can be performed by using the bump electrodes 12 and 12.





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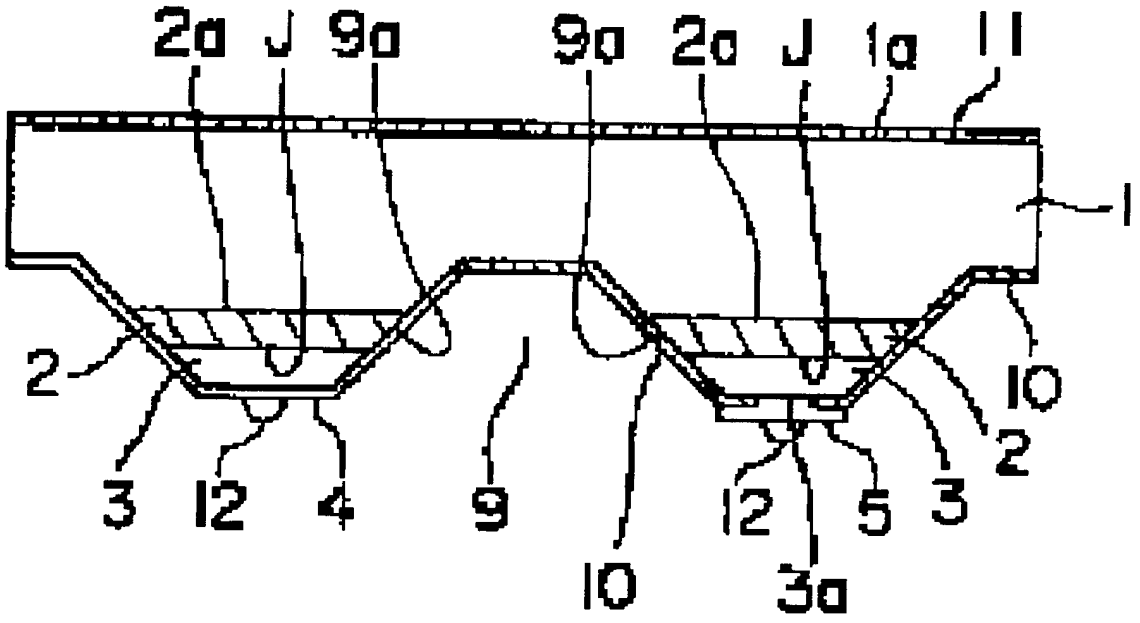
ABSTRACT:
PURPOSE: To provide a semiconductor light emitting device which can be improved in light emitting efficiency and, at the same time, can be easily mounted.

CONSTITUTION: This device is provided with a groove 9 which reaches an N-type substrate 1 from the surface 3a of a P-type semiconductor section 3 counterposed to a P-N junction surface J through the P-N junction surface J and N-type semiconductor section 2 and a P- and N-electrodes 5 and 4 formed on the surface 3a on both sides of the groove 9. In addition, bump electrodes 12 are respectively installed to the electrodes 5 and 4. Therefore, no light intercepting electrode is formed on the light emitting surface 1a of the device. In addition, flip chip bonding can be performed by using the bump electrodes 12 and 12.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* NOTICES *

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DETAILED DESCRIPTION

[Detailed description]
[0001]
[Field of the Invention] This invention can take out efficiently the light generated near the PN junction outside, and relates to the semiconductor photogenesis equipment which can be mounted easily.
[0002]
[Prior art] Conventionally, there is what is shown in drawing 6 as this kind of semiconductor photogenesis equipment. This semiconductor photogenesis equipment 60 is produced as follows. That is, on the N type substrate 61, the N-type semiconductor section 62 and the P type semiconductor section 63 are formed in order by the epitaxial grown method, next the metallic material for ohmic contacts is made to adhere to the required fraction of the whole front face of the above-mentioned N type substrate 61, and the front face of the P type semiconductor section 63, and the N electrode 64 and the P electrode 65 are formed. Next, it chip-izes by the dicing saw or the scribe machine.
[0003] The example of a package of the above-mentioned semiconductor photogenesis equipment 60 is shown in drawing 7 . Die bond of the N electrode 64 of the above-mentioned semiconductor photogenesis equipment is carried out to the leadframe 67 with the conductive pastes 66, such as a silver paste. Moreover, the P electrode 65 of the above-mentioned semiconductor photogenesis equipment is connected to the leadframe 70 with lead wire 68. And as shown in drawing 7 , the mould by the translucency resin 69 which covers the above-mentioned whole semiconductor photogenesis equipment 60 is made.
[0004] If a voltage is impressed to the above-mentioned P electrode 65 and the N electrode 64, the above-mentioned semiconductor photogenesis equipment 60 will generate light near the PN-junction side of the above-mentioned N-type semiconductor section 62 and the above-mentioned P type semiconductor section 63, and will be made to take out this light from optical outgoing-radiation side 63a by the side of the P electrode 65 of the above-mentioned P type semiconductor section 63.
[0005]
[Object of the Invention] However, the above-mentioned conventional semiconductor photogenesis equipment has the various faults which are described below.
[0006] (1) Since the process which turns the N electrode 64 down and carries out die bond of the N electrode 64 to a leadframe 67, and the process which connects the upper P electrode 65 to a leadframe 67 with lead wire 68 are indispensable when semiconductor photogenesis equipment 60 is mounted in a leadframe, a package man day is large.
[0007] (2) The P electrode 65 on top serves as the face shield of photogenesis light, and optical outgoing-radiation luminous efficacy is bad in light at ********'s.
[0008] (3) Since the light which advances to a PN junction and a parallel direction penetrates from a perpendicular end face in longitudinal direction to the above-mentioned PN-junction side, the light which carries out the outgoing radiation only of the part from optical outgoing-radiation side 63a decreases, and optical outgoing-radiation luminous efficacy falls.
[0009] (4) The P type semiconductor section 63 of the above-mentioned semiconductor photogenesis equipment consists of GaP, GaAs, GaAlAs, GaAsP, etc., and since the refractive-index n is about 3.5, reflection factor R in optical outgoing-radiation side 63a of the above-mentioned P type semiconductor section 63 becomes about 30% to air, and becomes about 16% to an epoxy resin. For this reason, since a part of photogenesis light reflects inside by the above-mentioned optical outgoing-radiation side 63a and it is confined in the interior, optical outgoing-radiation luminous efficacy falls. In addition, the value of the above-mentioned reflection factor R was calculated from formula R=(n1-n2) 2/(n1+n2)2 of a fresnel when the advance orientation of light is perpendicular to an interface.
[0010] (5) Since the interface reflection factor of the N type substrate 61 and a silver paste is about 50%, as it is shown in drawing 7 , when the above-mentioned semiconductor photogenesis equipment 60 is mounted in a leadframe 67 using the conductive paste 66 which consists of a silver paste, about 50% of the photogenesis light which advanced toward the interface of the N type substrate 61 and a silver paste will be absorbed by the silver paste from the above-mentioned interface.
[0011] Then, the purpose of this invention can cancel the fault of above-mentioned (1) - (5), and is to be able to raise optical outgoing-radiation luminous efficacy, and offer the semiconductor photogenesis equipment with an easy package.
[0012]
[The means for solving a technical problem] In order to attain the above-mentioned purpose, the semiconductor photogenesis equipment of a claim 1 In the semiconductor photogenesis equipment made to generate light near the plane of composition of

the 1st conductivity-type layer and the 2nd conductivity-type layer one side of the opposite side of the above-mentioned 2nd conductivity-type layer which counters the opposite side or the above-mentioned plane of composition of the above-mentioned 1st conductivity-type layer which counters the above-mentioned plane of composition to the above-mentioned plane of composition -- penetrating -- the [ the above-mentioned 2nd conductivity-type layer or ] -- with the slot which reaches 1 conductivity-type layer the [ the opposite side of the above-mentioned 1st conductivity-type layer, or ] -- with the positive electrode and negative electrode which were prepared in one side of the opposite side of 2 conductivity-type layer across the above-mentioned slot the salient electrode prepared in the above-mentioned positive electrode and the negative electrode -- having -- a plane of composition near [ above-mentioned ] -- generating -- the [ the opposite side of the above-mentioned 1st conductivity-type layer, or ] -- it is characterized by taking out outside the light which passed through another side of the opposite side of 2 conductivity-type layer

[0013] Moreover, it is carrying out [ that reflect in the above-mentioned inclined plane and the semiconductor photogenesis equipment of a claim 2 was made to make the light which makes the side face of the above-mentioned slot an inclined plane to the above-mentioned plane of composition occurs near / plane of composition / the above, and advances to abbreviation parallel at the above-mentioned plane of composition go to the opposite side of above-mentioned another side in semiconductor photogenesis equipment given in a claim 1 so that the above-mentioned slot may become a taper toward the base of the above-mentioned slot, and ] as the characteristic feature.

[0014] Moreover, it is characterized by the semiconductor photogenesis equipment of a claim 3 forming an antireflection film in the optical outgoing-radiation side for taking out outside the light which emitted light in semiconductor photogenesis equipment given in claims 1 or 2.

[0015] Moreover, the semiconductor photogenesis equipment of a claim 4 is set to the claim 1 or the semiconductor photogenesis equipment of any one publication of three. It is characterized by reflecting in either [ at least ] above-mentioned one opposite side or the side face of the above-mentioned slot by the above-mentioned reflective layer, and making at least one side of the light which tends toward the side face of the light which prepares a reflective layer and goes to above-mentioned one opposite side, or the above-mentioned slot go in the opposite side of above-mentioned another side to it.

[0016] Moreover, the semiconductor photogenesis equipment of a claim 5 is set to the semiconductor photogenesis equipment made to generate light near the plane of composition of the 1st conductivity-type layer and the 2nd conductivity-type layer. one side of the opposite side of the above-mentioned 2nd conductivity-type layer which counters the opposite side or the above-mentioned plane of composition of the above-mentioned 1st conductivity-type layer which counters the above-mentioned plane of composition to the above-mentioned plane of composition -- penetrating -- the [ the above-mentioned 2nd conductivity-type layer or ] -- with the slot which reaches 1 conductivity-type layer The heights of the 2nd conductivity type which is formed in the above-mentioned slot base, separates a predetermined spacing between the side faces of the above-mentioned slot, and crosses the above-mentioned plane of composition, or the 1st conductivity type, the the opposite side of the above-mentioned 1st conductivity-type layer, or ] -- with the positive electrode and negative electrode which were prepared in one side of the opposite side of 2 conductivity-type layer, and the top of the above-mentioned heights across the space between the side face of the above-mentioned slot, and a heights the salient electrode prepared in the above-mentioned positive electrode and the negative electrode -- having -- a plane of composition near [ above-mentioned ] -- generating -- the [ the opposite side of the above-mentioned 1st conductivity-type layer, or ] -- it is characterized by taking out outside the light which passed through another side of the opposite side of 2 conductivity-type layer

[0017] Moreover, the semiconductor photogenesis equipment of a claim 6 is set to semiconductor photogenesis equipment given in a claim 5. So that the space between the side face of the above-mentioned slot and the above-mentioned heights may become a taper toward the base of the above-mentioned slot It is characterized by reflecting in the above-mentioned inclined plane and making the light which the side face of the above-mentioned slot and the side face of the above-mentioned heights are formed in the inclined plane to the above-mentioned plane of composition, occurs near [ plane of composition ] the above, and advances to abbreviation parallel at the above-mentioned plane of composition go to the opposite side of above-mentioned another side.

[0018] Moreover, it is characterized by the semiconductor photogenesis equipment of a claim 7 forming an antireflection film in the optical outgoing-radiation side for taking out outside the light which emitted light in semiconductor photogenesis equipment given in claims 5 or 6.

[0019] Moreover, the semiconductor photogenesis equipment of a claim 8 is set to the claim 5 or the semiconductor photogenesis equipment of any one publication of seven. A reflective layer is prepared in at least one of above-mentioned one opposite side, the side face of the above-mentioned slot, or the side faces of the above-mentioned heights. It is characterized by reflecting by the above-mentioned reflective layer and making at least one of the light which tends toward the side face of the light which tends toward the side face of the light which goes to above-mentioned one opposite side, or the above-mentioned slot, or the above-mentioned heights go to the opposite side of above-mentioned another side.

[0020]

[Operation] The semiconductor photogenesis equipment of the above-mentioned claim 1 prepares both a positive electrode and a negative electrode in one side of the opposite side of the 2nd conductivity-type layer which counters the opposite side or the above-mentioned plane of composition of the 1st conductivity-type layer which counters the above-mentioned plane of composition across the above-mentioned slot, and took out light from another side of the opposite side of the 2nd

conductivity-type layer which counters at the opposite side or the above-mentioned plane of composition of the 1st conductivity-type layer outside. Therefore, according to invention of a claim 1, it becomes unnecessary to form an electrode in the field, i.e., the optical outgoing-radiation side, which takes out light. Therefore, according to invention of a claim 1, optical outgoing-radiation luminous efficacy can be raised.

[0021] Moreover, since both the positive electrode and the negative electrode were prepared in above-mentioned one opposite side and the salient electrode was prepared in this positive electrode and negative electrode, the package by the flip chip bonding which does not use lead wire is attained, and it can mount easily.

flip-chip mount

[0022] Moreover, according to invention of a claim 2, it reflects in the above-mentioned inclined plane, and the light which makes the side face of the above-mentioned slot an inclined plane to the above-mentioned plane of composition, occurs near plane of composition ] the above, and advances to abbreviation parallel at the above-mentioned plane of composition is made to go to the opposite side of above-mentioned another side so that the above-mentioned slot may become a taper toward the base of the above-mentioned slot. Therefore, the side face of the above-mentioned slot can raise optical outgoing-radiation luminous efficacy to the above-mentioned plane of composition compared with the case of being perpendicular.

[0023] Moreover, according to invention of a claim 3, the antireflection film is formed in the optical outgoing-radiation side for taking out outside the light which emitted light. Therefore, the outgoing radiation of the light which could prevent that photogenesis light reflected in respect of [ above-mentioned ] an optical outgoing radiation, and carried out above-mentioned ] photogenesis can be carried out from an optical outgoing-radiation side, and optical outgoing-radiation luminous efficacy can be raised.

[0024] Moreover, according to invention of a claim 4, a reflective layer is prepared in either [ at least ] above-mentioned one opposite side or the side face of the above-mentioned slot, at least one side of the light which tends toward the light or the above-mentioned side face in which it goes to above-mentioned one opposite side is reflected in it by the above-mentioned reflective layer, and it is made to go in the opposite side of above-mentioned another side to it. Therefore, since it can prevent that the light which carried out incidence to above-mentioned one opposite side or the side face of the above-mentioned slot with the incident angle within a critical angle penetrates and the above-mentioned light can be taken out now from an optical outgoing-radiation side outside, optical outgoing-radiation luminous efficacy improves.

[0025] the heights in which the semiconductor photogenesis equipment of the above-mentioned claim 5 was formed into the slot which penetrates the above-mentioned plane of composition -- having -- the space between the side face of the above-mentioned slot, and a heights -- inserting -- the [ the above 1st or ] -- one side of the opposite side of 2 conductivity-type layer, and the top of the above-mentioned heights -- both a positive electrode and a negative electrode -- preparing -- the [ the opposite side of the 1st conductivity-type layer, or ] -- light was taken out from another side of the opposite side Therefore, according to invention of a claim 5, it becomes unnecessary to form an electrode in the field, i.e., the optical outgoing-radiation side, which takes out light. Therefore, according to invention of a claim 5, optical outgoing-radiation luminous efficacy can be raised.

[0026] Moreover, since both the positive electrode and the negative electrode were prepared in above-mentioned one opposite side and the salient electrode was prepared in this positive electrode and negative electrode, the package by the flip chip bonding which does not use lead wire is attained, and it can mount easily.

[0027] Moreover, according to invention of a claim 6, it reflects in the above-mentioned inclined plane, and the light which makes an inclined plane the side face of the above-mentioned slot and the side face of the above-mentioned heights to the above-mentioned plane of composition, occurs near [ plane of composition ] the above, and advances to abbreviation parallel at the above-mentioned plane of composition is made to go to the opposite side of above-mentioned another side so that the space between the side face of the above-mentioned slot and the above-mentioned heights may become a taper toward the base of the above-mentioned slot. Therefore, the side face of the above-mentioned slot and the side face of the above-mentioned heights can raise optical outgoing-radiation luminous efficacy to the above-mentioned plane of composition compared with the case of being perpendicular.

[0028] Moreover, according to invention of a claim 7, the antireflection film is formed in the optical outgoing-radiation side for taking out outside the light which emitted light. Therefore, the outgoing radiation of the light which could prevent that photogenesis light reflected in respect of [ above-mentioned ] an optical outgoing radiation, and carried out above-mentioned ] photogenesis can be carried out from an optical outgoing-radiation side, and optical outgoing-radiation luminous efficacy can be raised.

[0029] Moreover, according to invention of a claim 8, a reflective layer is prepared in at least one of above-mentioned one opposite side, the side face of the above-mentioned slot, or the side faces of the above-mentioned heights of **, at least one of the light which tends toward the side face of the light which tends toward the light or the above-mentioned side face in which it goes to above-mentioned one opposite side, or the above-mentioned heights is reflected by the above-mentioned reflective layer, and it is made to go to the opposite side of above-mentioned another side. Therefore, since it can prevent that the light which carried out incidence to above-mentioned one opposite side, the side face of the above-mentioned slot, or the side face of the above-mentioned heights with the incident angle within a critical angle penetrates and the above-mentioned light can be taken out now from an optical outgoing-radiation side outside, optical outgoing-radiation luminous efficacy improves.

[0030]

[Example] Hereafter, the example of illustration of this invention explains in detail.

[0031] The 1st example of the semiconductor photogenesis equipment of this invention is explained, referring to drawing 1

along with the manufacturing process.

[0032] First, as shown in drawing 1 (A), the slot 9 of the depth which passes surface 3a to PN-junction side J on the front face 3 of an epitaxial layer of the wafer which formed the N-type semiconductor section 2 and the P type semiconductor section 3 one by one, and produced them by the epitaxial grown method, i.e., the P type semiconductor section, and reaches on the N type substrate 1 at the above-mentioned N type substrate 1 is formed by dicing or etching. In addition, inclined-plane 9a of the above-mentioned slot 9 was made to become 30 degrees - 60 degrees about angle theta made with the above-mentioned PN-junction side J at the time of formation of the above-mentioned slot 9. That is, the above-mentioned slot 9 is a taper toward the base 9b.

[0033] Next, as shown in drawing 1 (B), it forms in the inclined planes 9a and 9a of the couple which sandwiches heights M into which a slot 9 and the slot 9 insert the reflective layer 10 prolonged from inclined-plane 9a of the above-mentioned slot 9 in surface 3a of the above-mentioned P type semiconductor section 3, and base 9b of the above-mentioned slot 9. The above-mentioned reflective layer 10 is alternately formed in the above-mentioned heights M. The above-mentioned reflective layer 10 is a dielectric multilayer which has four pairs of pairs of SiO2 (refractive index n= 1.46) of optical thickness (refractive-index nx thickness d) =(1/4) -lambdap [nm], and TiO2 (refractive index n= 2.3) of optical thickness (refractive-index nx thickness d) =(1/4) -lambdap [nm]. Here, lambdap [nm] is photogenesis wavelength. Pattern formation is carried out by a photolithography and wet etching, or pattern formation is carried out by the lift-off method.

[0034] Next, it is formation **** about the positive (P) electrode 5 to the front face of the reflector 10 formed in surface 3a and this surface 3a of the P type semiconductor section 3 of heights M in which the above-mentioned reflective layer 10 was formed as shown in drawing 1 (C). This P electrode 5 consists of Au/AuZn, and is formed of vacuum evaporationo, a photolithography, and wet etching. Moreover, the negative (N) electrode 4 is formed in a part of slot base 9b which adjoins the inclined planes 9a and 9a which adjoin next surface 3a and this next surface 3a of the P type semiconductor section 3 of heights M in which the above-mentioned reflective layer 10 was formed, and this inclined-plane 9a. [ of heights M ] This N electrode 4 consists of AuGe/nickel, and is formed of vacuum evaporationo, a photolithography, and wet etching. Electrically, the N electrode 4 will short-circuit the N-type semiconductor section 2 and the P type semiconductor section 3, and they will carry out [ electrode ] electrical installation to the N type substrate 1. That is, the heights by the side of the above-mentioned N electrode 4 is formed as an object for electrode derivation.

[0035] Next, as shown in drawing 1 (D), an antireflection film 11 is formed in surface 1a of the N type substrate 1. This antireflection film 11 consists of TiO2 (refractive index n= 2.3) of optical thickness nxd=(1/4) -lambdap [nm].

[0036] Next, as shown in drawing 1 (E), the bump electrode 12 which consists of Au, solder, etc. is formed in the front face of the N electrode 4 in the field which counters with surface 3a of the above-mentioned P type semiconductor section 3. Moreover, the bump electrode 12 which consists of Au, solder, etc. is formed in the front face of the P electrode 5 in the field which counters with surface 3a of the P type semiconductor section 3.

[0037] And finally, dicing divides the wafer shown in drawing 1 (E), and the chip which shows drawing 2 is produced. This chip is, the semiconductor photogenesis equipment, i.e., the light emitting diode, of this example.

[0038] The semiconductor photogenesis equipment of the above-mentioned configuration will emit light near the PN-junction side J which counters the above-mentioned P electrode 5, if a voltage is impressed between the P electrode 5 and the N electrode 4. In PN-junction side J which counters the N electrode 4, it has connected too hastily like the above and light is not emitted. The photogenesis light by the above-mentioned photogenesis passes opposite side 2a of the N-type semiconductor section 2 which counters the above-mentioned PN-junction side J, and it carries out an outgoing radiation outside, surface 1a, i.e., the optical outgoing-radiation side, of the N type substrate 1.

[0039] Moreover, light is emitted near the above-mentioned PN-junction side J, and it is reflected by the reflective layer 10 formed in the above-mentioned inclined-plane 9a, and the light which reached inclined-plane 9a of the above-mentioned slot 9 progresses toward the above-mentioned optical outgoing-radiation side, and carries out an outgoing radiation outside from the above-mentioned optical outgoing-radiation side.

[0040] Moreover, it is reflected by the reflective layer 10 in surface 3a of the above-mentioned P type semiconductor section 3, and the light which emits light near the above-mentioned PN-junction side J, advances to the above-mentioned optical outgoing-radiation side and an opposite direction, and goes to the P electrode 5 progresses toward the above-mentioned optical outgoing-radiation side, and carries out an outgoing radiation outside from the above-mentioned optical outgoing-radiation side.

[0041] While the above-mentioned semiconductor photogenesis equipment formed the P electrode 5 and the N electrode 4 in surface 3a of the P type semiconductor section 3 which faces across a slot 9, it made surface 1a of the N type substrate 1 which counters the above-mentioned surface 3a on both sides of the above-mentioned PN-junction side J the optical outgoing-radiation side. That is, since this example does not form electrodes 5 and 4 in an optical outgoing-radiation side, it does not interrupt the light in which electrodes 5 and 4 carry out an outgoing radiation from an optical outgoing-radiation side. Therefore, according to this example, optical outgoing-radiation luminous efficacy can be raised compared with the conventional example which needs to form an electrode in an optical outgoing-radiation side.

[0042] Moreover, since the bump electrode 12 was formed in the P electrode 5 and the N electrode 4 which were formed in surface 3a of the above-mentioned P type semiconductor section 3, the package by the flip chip bonding which does not use lead wire is attained, and this example can be mounted easily.

[0043] Moreover, the side face of the above-mentioned slot 9 is set to inclined-plane 9a to the above-mentioned PN-junction

side J so that the above-mentioned slot 9 may become a taper toward the base 9b. Since it reflects by the above-mentioned inclined-plane 9a and it was made to make the light which occurs near [ PN-junction side J ] the above, and advances to abbreviation parallel at the above-mentioned PN-junction side J go to surface 1a (optical outgoing-radiation side) of the above-mentioned N type substrate 1 The side face of the above-mentioned slot 9 can raise optical outgoing-radiation luminous efficacy to the above-mentioned plane-of-composition J compared with the case of being perpendicular.
[0044] Moreover, since the antireflection film 11 was formed in surface 1a (optical outgoing-radiation side) for taking out outside the light which emitted light, it can prevent that photogenesis light reflects in respect of [ above-mentioned ] an optical outgoing radiation, and optical outgoing-radiation luminous efficacy can be raised.
[0045] Moreover, since it can prevent that the photogenesis light which carried out incidence to the above-mentioned surface 3a or the above-mentioned inclined-plane 9a with the incident angle within a critical angle penetrates since the reflective layer 10 was formed in surface 3a of the above-mentioned P type semiconductor section 3, and the above-mentioned inclined-plane 9a, the above-mentioned photogenesis light can be reflected by the above-mentioned reflective layer 10 and it can take out now from an optical outgoing-radiation side outside, optical outgoing-radiation luminous efficacy improves. Furthermore, since the above-mentioned reflective layer 10 is an insulator layer containing SiO2 layer and TiO2 layer, it prevents that each semiconductor section short-circuits the above-mentioned reflective layer 10 electrically with the conductive paste used at the time of die bond when this example is mounted, or solder. In addition, in the above-mentioned example, although inclined-plane 9a was made into the flat surface, you may make inclined-plane 9a into a curved surface.
flat surface or curved
[0046] Next, the 2nd example of this invention is explained, referring to drawing 3 along with the manufacturing process.
[0047] First, as shown in drawing 3 (A), the slot 39 of the depth which passes surface 33a to PN-junction side K on the front face 33 of an epitaxial layer of the wafer which formed the N-type semiconductor section 32 and the P type semiconductor section 33 one by one, and produced them by the epitaxial grown method, i.e., the P type semiconductor section, and reaches on the N type substrate 31 at the above-mentioned N type substrate 31 is formed by dicing or etching. In addition, it is desirable to make into 30 degrees - 60 degrees the angle theta 1 which side face 39a of the above-mentioned slot 39 makes with the above-mentioned PN-junction side K at the time of formation of the above-mentioned slot 39. That is, as for the above-mentioned slot 39, it is desirable to make it a taper toward the base 39b. By forming this slot 39, heights W which contains PN-junction side K in the both sides of a slot 39 is formed.
[0048] Next, as shown in drawing 3 (B), an epitaxial grown method is used and the N-type semiconductor section 42 is embedded in a slot 39. Then, surface 33a of the above-mentioned P type semiconductor section 33 and surface 42a of the above-mentioned N-type semiconductor section 42 are ground.
[0049] Next, as shown in drawing 3 (C), the slot 43 through which crosses the above-mentioned PN-junction side K, and it passes by etching or dicing from surface 42a of the above-mentioned N-type semiconductor section 42 is formed. While this slot 43 is side face 39a of the above-mentioned slot 39 is as symmetrical as side face 43a about side face 43a and a perpendicular, and also it has side face 43b of a way, and the above-mentioned side face 43a and side face 43b cross at the maximum ****, and are making the acute angle. By forming this slot 43, heights Z which consists of an N-type semiconductor which does not include a PN-junction side through a slot 43 between heights W and heights W containing the above-mentioned PN-junction side K is formed. This heights Z is the configuration of heights W and an abbreviation identity. And abbreviation etc. is carried out and the angle's [ theta 2 ] which the extended field of PN-junction side K and the above-mentioned side face 43b make is in the above-mentioned angle theta 1.
[0050] Next, as shown in drawing 3 (D), the reflective layer 44 is formed in the circumference section of side face 39a of the slot 39 which is the side face of the above-mentioned heights W, and surface 33a of the above-mentioned P type semiconductor section 33, side face 43b of the slot 43 which is the side face of the above-mentioned heights Z, and the circumference section of the top of the above-mentioned heights Z. This reflective layer 44 is a dielectric multilayer which has eight pairs of pairs of SiO2 (refractive index n= 1.46) of optical thickness (refractive-index nx thickness d) =(1/4) -lambdaP [nm], and TiO2 (refractive index n= 2.3) of optical thickness (refractive-index nx thickness d) =(1/4) -lambdap [nm]. Here, lambdap [nm] is photogenesis wavelength. Pattern formation of this dielectric multilayer is carried out by a photolithography and wet etching, or pattern formation is carried out by the lift-off method.
[0051] Next, as shown in drawing 3 (E), the positive (P) electrode 35 is formed in the center section of surface 33a of the P type semiconductor section 33 which is the top of heights W containing the above-mentioned PN-junction side K, and the negative (N) electrode 34 is formed in the top of heights Z which does not contain the above-mentioned PN-junction side K. The above-mentioned positive electrode 35 consists of Au/AuZn, and is formed of vacuum evaporationo, a photolithography, and wet etching. Moreover, the above-mentioned negative electrode 34 consists of AuGe/nickel, and is formed of vacuum evaporationo, a photolithography, and wet etching. Heights Z by the side of this negative electrode 34 is formed as an object for electrode derivation.
[0052] Next, as shown in drawing 3 (E), an antireflection film 45 is formed in surface 31a of the N type substrate 31. This antireflection film 45 is formed by TiO2 (refractive index n= 2.3) of optical thickness nxd=(1/4) -lambdap [nm].
[0053] Next, as shown in drawing 3 (E), the bump electrode 46 which consists of Au, solder, etc. is formed in the front face of the above-mentioned N electrode 34, and the front face of the P electrode 35.
[0054] And finally, dicing or a cleavage divides the wafer shown in drawing 3 (E), and the chip which shows drawing 4 is produced. This chip is, the semiconductor photogenesis equipment, i.e., the light emitting diode, of this example.
[0055] The semiconductor photogenesis equipment of the above-mentioned configuration will emit light near the PN-junction

side K which counters the above-mentioned P electrode 35, if a voltage is impressed between the P electrode 35 and the N electrode 34. The photogenesis light by the above-mentioned photogenesis passes opposite side 32a of the N-type semiconductor section 32 which counters the above-mentioned PN-junction side K, and it carries out an outgoing radiation outside, surface 31a, i.e., the optical outgoing-radiation side, of the N type substrate 31.
[0056] Moreover, light is emitted near the above-mentioned PN-junction side K, and it is reflected by the reflective layer 44 formed in the above-mentioned inclined-plane 43a, and the light which reached inclined-plane 43a of the above-mentioned slot 43 progresses toward the above-mentioned optical outgoing-radiation side, and carries out an outgoing radiation outside from the above-mentioned optical outgoing-radiation side.
[0057] Moreover, it is reflected by the reflective layer 44 in surface 33a of the above-mentioned P type semiconductor section 33, and the light which emits light near the above-mentioned PN-junction side K, advances to the above-mentioned optical outgoing-radiation side and an opposite direction, and goes to the P electrode 35 progresses toward the above-mentioned optical outgoing-radiation side, and carries out an outgoing radiation outside from the above-mentioned optical outgoing-radiation side. While the above-mentioned semiconductor photogenesis equipment formed the P electrode 35 and the N electrode 34 in the top of heights W and the top of heights Z which face across a slot 43, it made surface 31a of the N type substrate 31 by the side of the base of the above-mentioned heightss W and Z the optical outgoing-radiation side. That is, since this example does not form electrodes 35 and 34 in an optical outgoing-radiation side, it does not interrupt the light in which electrodes 35 and 34 carry out an outgoing radiation from an optical outgoing-radiation side. Therefore, according to this example, optical outgoing-radiation luminous efficacy can be raised compared with the conventional example which needs to form an electrode in an optical outgoing-radiation side.
[0058] Moreover, since the bump electrode 46 was formed in the P electrode 35 on heights W, and the N electrode 34 on heights Z, the package by the flip chip bonding which does not use lead wire is attained, and this example can be mounted easily. For example, as shown in drawing 5 , this example 50 can be easily mounted in a leadframe 57 by the flip chip bonding which used the conductive paste 56. In drawing 5 , 59 is a translucency resin.
[0059] Moreover, side face 43a of the above-mentioned slot 43 is made into an inclined plane to the above-mentioned PN-junction side K so that the above-mentioned slot 43 may become a taper toward the base. Since it reflects by the above-mentioned side face 43a and it was made to make the light which occurs near [ PN-junction side K ] the above, and advances to abbreviation parallel at the above-mentioned PN-junction side K go to surface 31a (optical outgoing-radiation side) of the above-mentioned N type substrate 31 Side face 43a of the above-mentioned slot 43 can raise optical outgoing-radiation luminous efficacy to the above-mentioned plane-of-composition K compared with the case of being perpendicular.
[0060] Moreover, since the antireflection film 45 was formed in surface 31a (optical outgoing-radiation side) for taking out outside the light which emitted light, it can prevent that photogenesis light reflects in respect of [ above-mentioned ] an optical outgoing radiation, and optical outgoing-radiation luminous efficacy can be raised.
[0061] Moreover, since it can prevent that the photogenesis light which carried out incidence to the above-mentioned surface 33a or the above-mentioned side face 43a with the incident angle within a critical angle penetrates since the reflective layer 44 was formed in surface 33a of the above-mentioned P type semiconductor section 33, and the above-mentioned side face 43a, the above-mentioned photogenesis light can be reflected by the above-mentioned reflective layer 44 and it can take out now from an optical outgoing-radiation side outside, optical outgoing-radiation luminous efficacy improves. Moreover, by the above-mentioned photogenesis light-transmission prevention, as shown in conventional drawing 7 , it becomes unnecessary to carry out a leadframe 67 a cup configuration, and a cost cut can be aimed at.
[0062] Furthermore, since the above-mentioned reflective layer 44 is an insulator layer containing SiO2 layer and TiO2 </SUB> layer, it prevents that each semiconductor section short-circuits the above-mentioned reflective layer 44 electrically with the conductive paste used at the time of die bond when this example is mounted, or solder. Furthermore, the above-mentioned reflective layer 44 has the operation as a protective coat of a joint.
[0063] In addition, in the above-mentioned example, although side face 43a of a slot 43 was made into the flat surface, you may make side 43a into a curved surface.
[0064]
[Effect of the invention] As mentioned above, the semiconductor photogenesis equipment of invention of a claim 1 prepares both a positive electrode and a negative electrode in one side of the opposite side of the 2nd conductivity-type layer which counters the opposite side or the above-mentioned plane of composition of the 1st conductivity-type layer which counters the plane of composition of the 1st conductivity-type layer and the 2nd conductivity-type layer across the above-mentioned slot, and took out light from another side of the opposite side of the 2nd conductivity-type layer which counters at the opposite side or the above-mentioned plane of composition of the 1st conductivity-type layer outside so that clearly. That is, since invention of a claim 1 does not form the electrode in the field, i.e., the optical outgoing-radiation side, which takes out light, it cannot interrupt the light which carries out an outgoing radiation from an optical outgoing-radiation side by the electrode, and can raise optical outgoing-radiation luminous efficacy.
[0065] Moreover, since both the positive electrode and the negative electrode were prepared in above-mentioned one opposite side and the salient electrode was prepared in this positive electrode and negative electrode, the package by the flip chip bonding which does not use lead wire is attained, and it can mount easily.
[0066] Moreover, the semiconductor photogenesis equipment of a claim 2 makes the side face of the above-mentioned slot an

inclined plane to the above-mentioned plane of composition, reflects the light which occurs near [ plane of composition ] the above and advances to abbreviation parallel at the above-mentioned plane of composition in the above-mentioned inclined plane, and is made to go to the opposite side of above-mentioned another side so that the above-mentioned slot may become a taper toward the base of the above-mentioned slot. Therefore, the side face of the above-mentioned slot can raise optical outgoing-radiation luminous efficacy to the above-mentioned plane of composition compared with the case of being perpendicular.

[0067] Moreover, semiconductor photogenesis equipment given in a claim 3 forms the antireflection film in the optical outgoing-radiation side for taking out outside the light which emitted light. Therefore, it can prevent that photogenesis light reflects in respect of [ above-mentioned ] an optical outgoing radiation, the outgoing radiation of the above-mentioned photogenesis light can be carried out from an optical outgoing-radiation side, and optical outgoing-radiation luminous efficacy can be raised.

[0068] Moreover, semiconductor photogenesis equipment given in a claim 4 prepares a reflective layer in either [ at least ] above-mentioned one opposite side or the side face of the above-mentioned slot, reflects in it at least one side of the light which tends toward the side face of the light which goes to above-mentioned one opposite side, or the above-mentioned slot by the above-mentioned reflective layer, and is made to go in the opposite side of above-mentioned another side to it. Therefore, since it can prevent that the light which carried out incidence to above-mentioned one opposite side or the side face of the above-mentioned slot with the incident angle within a critical angle penetrates and the above-mentioned light can be taken out now from an optical outgoing-radiation side outside, optical outgoing-radiation luminous efficacy improves.

[0069] the semiconductor photogenesis equipment of invention of a claim 5 -- the space between the side face of a slot, and a heights -- inserting -- the [ the 1st or ] -- it has the heights formed in the slot which penetrates a plane of composition on one side of the opposite side of 2 conductivity-type layer, and the top of the above-mentioned heights, both a positive electrode and a negative electrode are prepared, and light was taken out from another side of the opposite side of the 2nd conductivity-type layer which counters the opposite side or the above-mentioned plane of composition of the That is, since invention of a claim 5 does not form the electrode in the field, i.e., the optical outgoing-radiation side, which takes out light, it cannot interrupt the light which carries out an outgoing radiation from an optical outgoing-radiation side by the electrode, and can raise optical outgoing-radiation luminous efficacy.

[0070] Moreover, since both the positive electrode and the negative electrode were prepared in above-mentioned one opposite side and the salient electrode was prepared in this positive electrode and negative electrode, the package by the flip chip bonding which does not use lead wire is attained, and it can mount easily.

[0071] Moreover, the semiconductor photogenesis equipment of a claim 6 makes an inclined plane the side face of the above-mentioned slot, and the side face of the above-mentioned heights to the above-mentioned plane of composition, reflects the light which occurs near [ plane of composition ] the above and advances to abbreviation parallel at the above-mentioned plane of composition in the above-mentioned inclined plane, and is made to go to the opposite side of above-mentioned another side so that the space between the side face of the above-mentioned slot and the above-mentioned heights may become a taper toward the base of the above-mentioned slot. Therefore, the side face of the above-mentioned slot and the side face of a heights can raise optical outgoing-radiation luminous efficacy to the above-mentioned plane of composition compared with the case of being perpendicular.

[0072] Moreover, semiconductor photogenesis equipment given in a claim 7 forms the antireflection film in the optical outgoing-radiation side for taking out outside the light which emitted light. Therefore, it can prevent that photogenesis light reflects in respect of [ above-mentioned ] an optical outgoing radiation, the outgoing radiation of the above-mentioned photogenesis light can be carried out from an optical outgoing-radiation side, and optical outgoing-radiation luminous efficacy can be raised.

[0073] Moreover, semiconductor photogenesis equipment given in a claim 8 prepares a reflective layer in at least one of above-mentioned one opposite side, the side face of the above-mentioned slot, or the side faces of the above-mentioned heights, reflects at least one of the light which tends toward the side face of the light which tends toward the side face of the light which goes to above-mentioned one opposite side, or the above-mentioned slot, or the above-mentioned heights by the above-mentioned reflective layer, and it is made to go to the opposite side of above-mentioned another side. Therefore, since it can prevent that the light which carried out incidence to above-mentioned one opposite side, the side face of the above-mentioned slot, or the side face of the above-mentioned heights with the incident angle within a critical angle penetrates and the above-mentioned light can be taken out now from an optical outgoing-radiation side outside, optical outgoing-radiation luminous efficacy improves.

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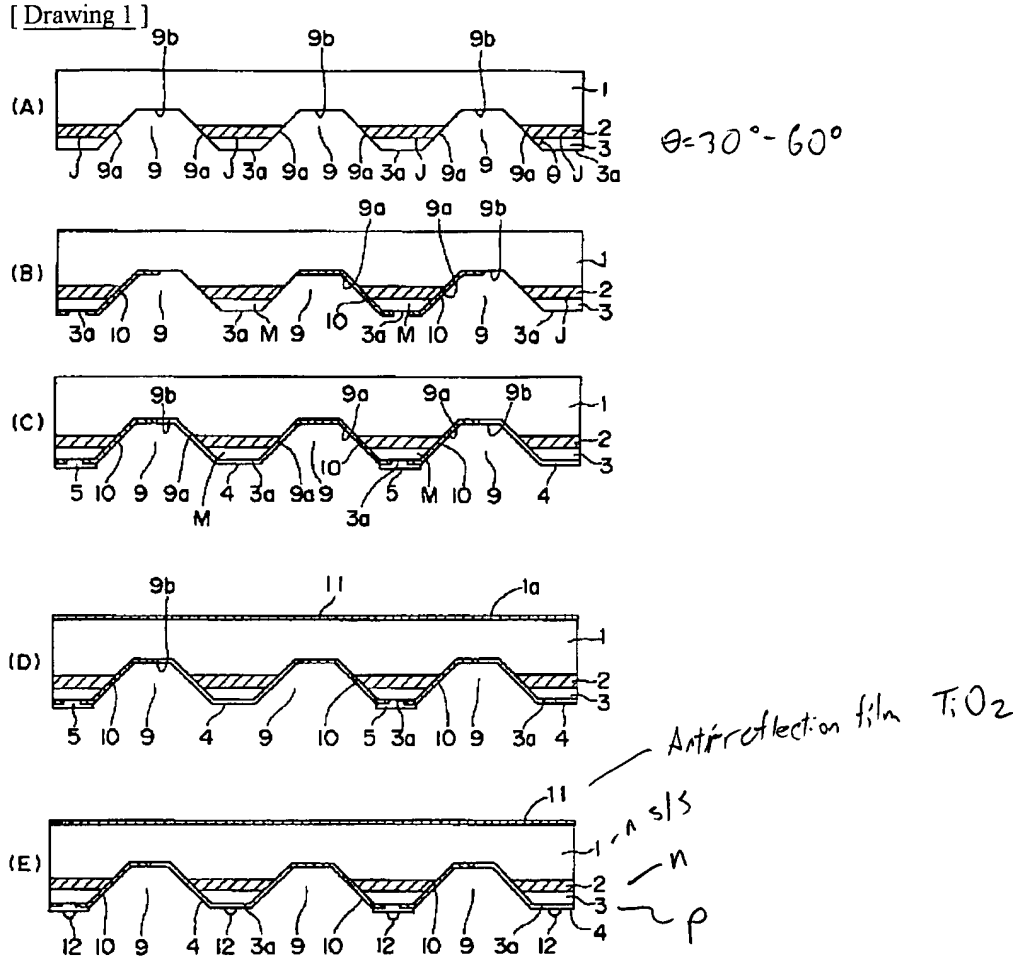
[Translation done.]

* NOTICES *

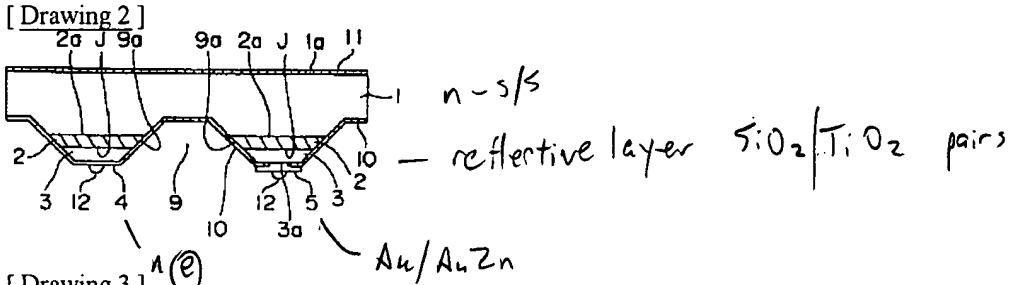


DRAWINGS

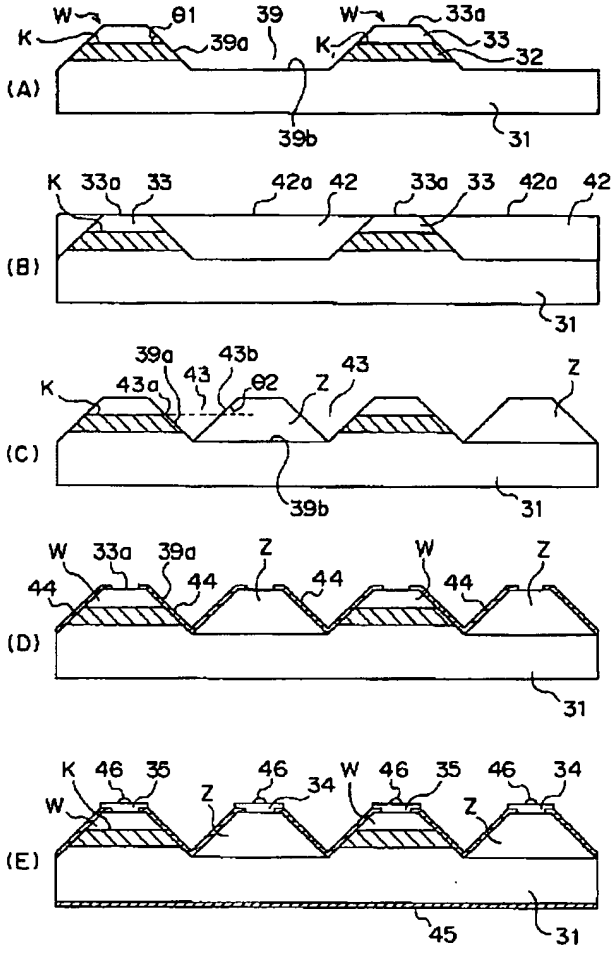
[ Drawing 1 ]



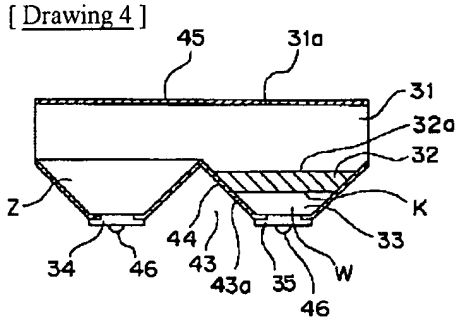

[ Drawing 2 ]



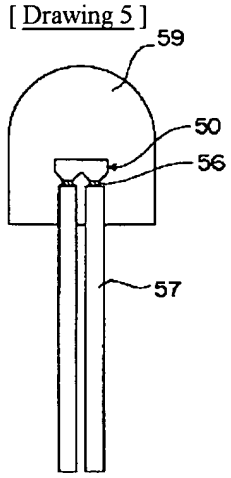

[ Drawing 3 ]



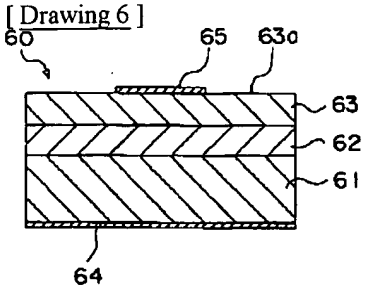

[ Drawing 4 ]




[ Drawing 5 ]

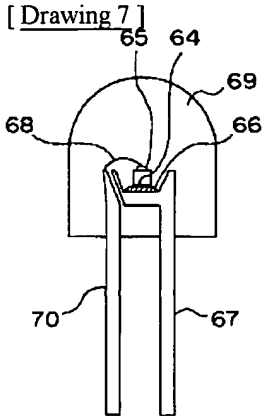


[Drawing 6]




PRIOR ART

[Drawing 7]

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[Translation done.]